Space Weather Technical Forecast

Issued on Monday, 06 May 2024 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares expected with a chance of isolated X-flares through the period. G1/G2 (Kp 5-6) conditions are possible on day 1 (6 May) given potential CME influence, with a slight chance of an isolated G3 (Kp7) interval. Lowering chance of further geomagnetic activity days 2 and 3 (7-8 May).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity reached high levels following two X1 flares from AR3663 at 05/0601 UTC and 05/1154 UTC, with numerous other M-flares from this region. AR3364 also contributed an M2 flare at 05/0938 UTC.

There are currently nine numbered sunspot regions on the visible disc. The most active remains AR3663, located in the northwest, and which features a large and complex intermediate spot with a delta configuration. This region has produced the largest flares in the past 24 hours. AR3664 is the second largest spot on the disc and located in the southeast, also with a delta configuration in its southern intermediate spot, where the bulk of the recent areal growth has occurred. AR3368, in the southeast, grew a little and was numbered, as was a persistent small spot further east (AR3369). The remaining sunspots on the disc are generally smaller, stable or in slight decay, and magnetically simple.

No obvious Earth directed CMEs have been observed, however updated LASCO/SOHO coronagraph imagery is currently unavailable, and STEREO-A imagery is limited, therefore confidence is lower than normal.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 were at background levels, 310-390km/s, but with a gentle rising trend in the UTC evening. Density varied between average to above average, but with a rising trend through the UTC evening, reaching a recent peak near 40 ppcc. The Interplanetary Magnetic Field, Bt, displayed similar trends with a recent peak around 14nT. The north-south component, Bz, varied weakly then transitioned into a sustained Moderate southward orientation during the UTC evening, peak -12nT. Phi angle showed periods of both positive (away from the Sun) and negative (towards the Sun). These parameters likely indicate some CME influence. Resultant Geomagnetic activity was predominantly Quiet (Kp 1-2), becoming Unsettled to Active (Kp 3-4) 05/1800-2359 UTC, as measured by BGS. Lerwick observatory recorded a G3/Strong Storm interval (Kp 7) just prior to midnight UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at normal background levels. High energy electron flux (greater than 2MeV) observed at GOES16 remained at largely background levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 06/0001UTC was 2.04e6 integrated pfu on a slight upward trend.

Four-Day Space Weather Forecast Summary

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Met Office Space Weather Technical Forecast

Solar Activity: Moderate to High solar activity is forecast to continue with further M-flares expected and a chance of isolated X-flares, principally from AR3663 and AR3664.

Solar Wind / Geomagnetic Activity: Three Earth-directed CMEs currently feature in the forecast period. The 01 May filament CME may yet provide a glancing impact early day 1 (06 May) although as a diminished possibility. The second a potentially more significant CME associated with the 03 May X-flare may also interact with Earth during day 1 (06 May), with the third possibly giving a glancing blow late day 1/early day 2 (6 to 7 May).

Some HSS influence from CH35/+ and CH33/+ is also expected into days 1 and 2 (06-07 May) and could see speeds peak at elevated levels before slowly declining although CME influence may mask this signal.

Combining effects from the various CMEs and HSS influences through the period results in a lower than average Geomagnetic forecast confidence.

Geomagnetic activity is expected to increase on day 1 (06 May), becoming Unsettled to Active with some G1/Minor Storm intervals possible, and a slight chance of isolated G2/Moderate to G3/Strong Storm conditions. Activity should generally subside through days 2-4 (07 to 09 May) to mostly Quiet conditions by the end of the period. Any glancing pass from 4 May CME could give a slight chance of reaching G1 levels late day 1/early day 2 (06 and 07 May).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels through the period. There is a slight chance for an S1/Minor Storm or greater event throughout however, primarily from AR3663.

High energy electron flux is forecast to be at background to moderate levels throughout, with associated fluence expected to remain well below the Active (1e8 integrated pfu) threshold.

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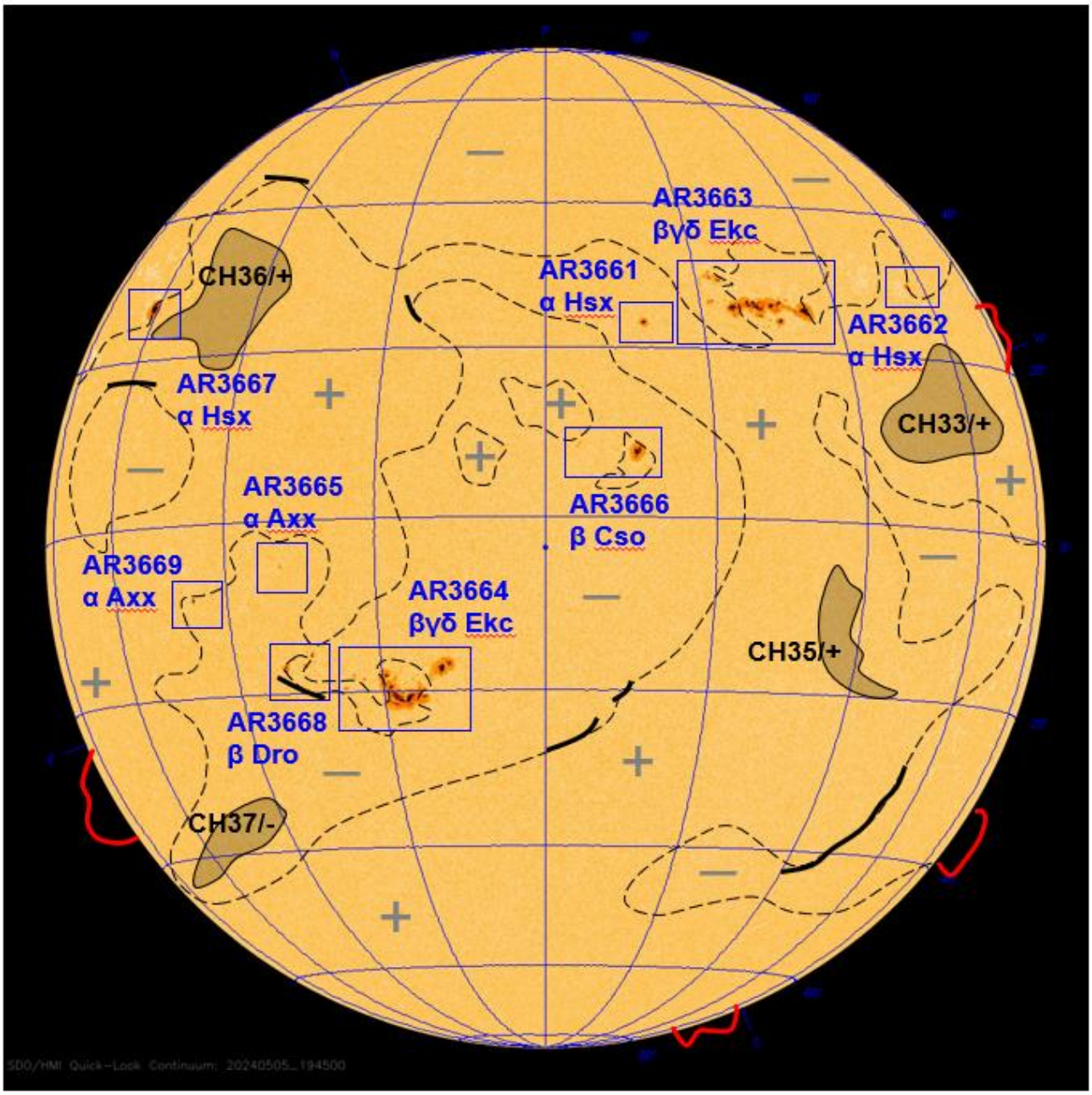
Figure 1. Solar Analysis Valid 05/2000 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Three Earth-directed CMEs currently feature in the forecast period. A CME that left the Sun around 01/0600 UTC from the southwest disc, resulting from a large filament eruption, may yet provide a glancing impact early day 1 (06 May), although as a diminished possibility. A potentially more significant Earth directed CME associated with the X1.6 flare 03/0222 UTC, may also interact with Earth during day 1 (06 May). Both features carry greater than average uncertainty with respect to timings and magnitude of effects, given limitations in imagery available for analysis. A largely northward directed CME followed the M9 flare on the 4th May, with modelling giving a possible glancing interaction late day 2/early day 2 (6 to 7 May), although once again limited imagery reduces confidence.

HSS enhancement from coronal holes CH33/+ and CH35/+ may also increase solar wind speeds on day 1 into day 2 (06-07 May) as these regions transit geo-effective longitudes. The coronal holes while broadly persistent are noticeably larger than the previous rotation and could see speeds peak at elevated levels between days 1 and 2 (06 and 07 May) before slowly declining, although CME influence may mask the signal.

The combination of possible influences of coronal holes and CMEs through the period, as well as ongoing gaps in imagery, results in a lower than average Geomagnetic forecast confidence throughout.

Geomagnetic activity is expected to increase on day 1 (06 May), becoming Unsettled to Active with some G1/Minor Storm intervals possible, and a slight chance of isolated G2/Moderate to G3/Strong Storm conditions. Activity should generally subside through days 2-4 (07 to 09 May) to mostly Quiet conditions by the end of the period. Any glancing pass from 4 May CME could give a slight chance of reaching G1 levels late day 1/early day 2 (06 and 07 May).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	20	5	1
Strong	G3	No	20	1	1	1
Severe	G4	No	5	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1259	Partial	Filament	SW	585 km/s	05/1200 UTC	Glance possible
03/0646	Partial	AR36663	NE	900 km/s	05/1800 UTC	Glance possible
04/1125	Partial	AR36663	NE	650 km/s	07/1200 UTC	Glance possible

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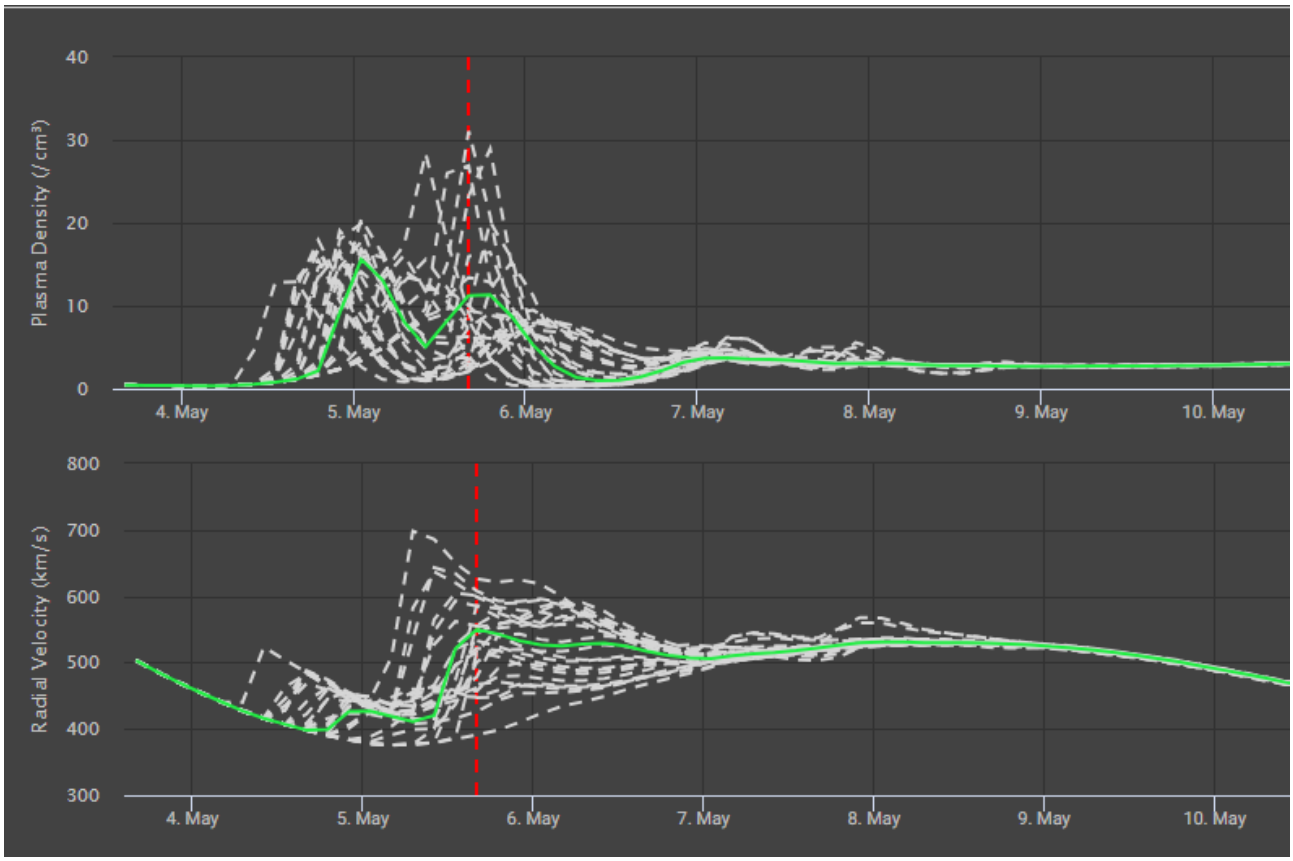
Figure 2: Latest MOSWOC Enlil ensemble output.



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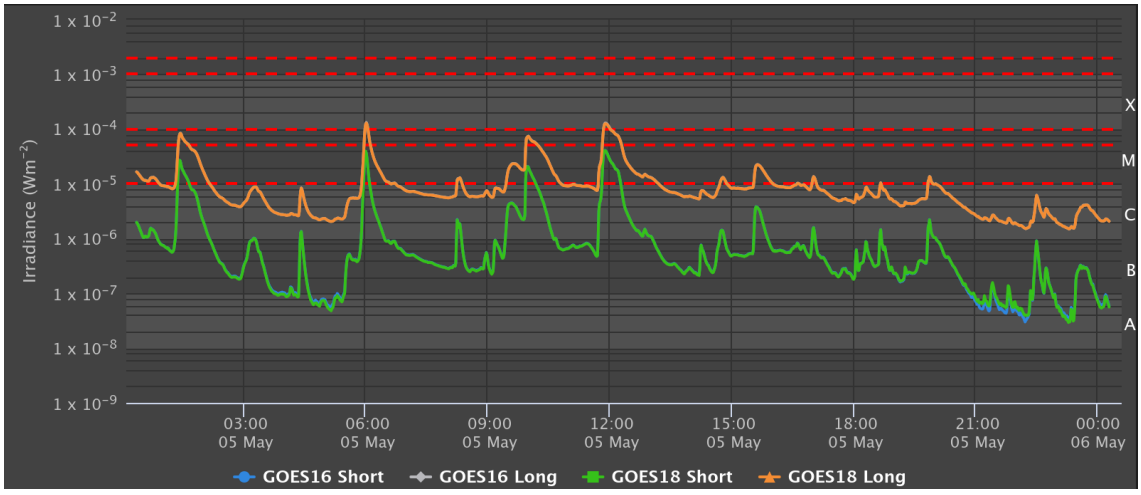
Radio Blackouts - X-Ray Flares:
Solar activity reached high levels following two X1 flares from AR3663, with numerous other M-flares from this region. AR3364 also contributed an M2 flare at 05/0938 UTC.

There are currently nine numbered sunspot regions on the visible disc. The most active remains AR3663, located in the northwest, and which features a large and complex intermediate spot with a delta configuration. This region has produced the largest flares in the past 24 hours. AR3664 is the second largest spot on the disc and located in the southeast, also with a delta configuration in its southern intermediate spot, where the bulk of the recent areal growth has occurred. AR3368, in the southeast, grew a little and was numbered, as was a persistent small spot further east (AR3369). The remaining sunspots on the disc are generally smaller, stable or in slight decay, and magnetically simple.

Both AR3663 and AR3664 remain on the visible disk throughout the period, and far-sided helioseismographs indicate a number of returning regions over the northeast horizon in the coming days that may supplement the present risk of significant flares should they persist. Moderate to High solar activity is therefore forecast to continue pending further developments, with occasional M-flares expected and a chance of isolated X-flares throughout, principally from AR3663 and perhaps to a lesser extent AR3664.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	90	90	90
Very Active	R3 to R5 X Class	Yes	25	25	25	25

Figure 3: Latest GOES16/18 X-ray flux plot.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. However, there is a slight chance of an S1/Minor Storm or greater event occurring throughout, primarily from AR3663 as it transits westward although recent significant flares from this region have so far failed to trigger any significant proton response.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux is at normal background levels. Likely CME and coronal hole influences through the period are expected to limit electron flux at background to moderate levels on all days.

Overall, the 24 hour integrated electron fluence is forecast to remain well below the Active (1e8 integrated pfu) threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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